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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: TELEVISION SIGNAL RECEIVER
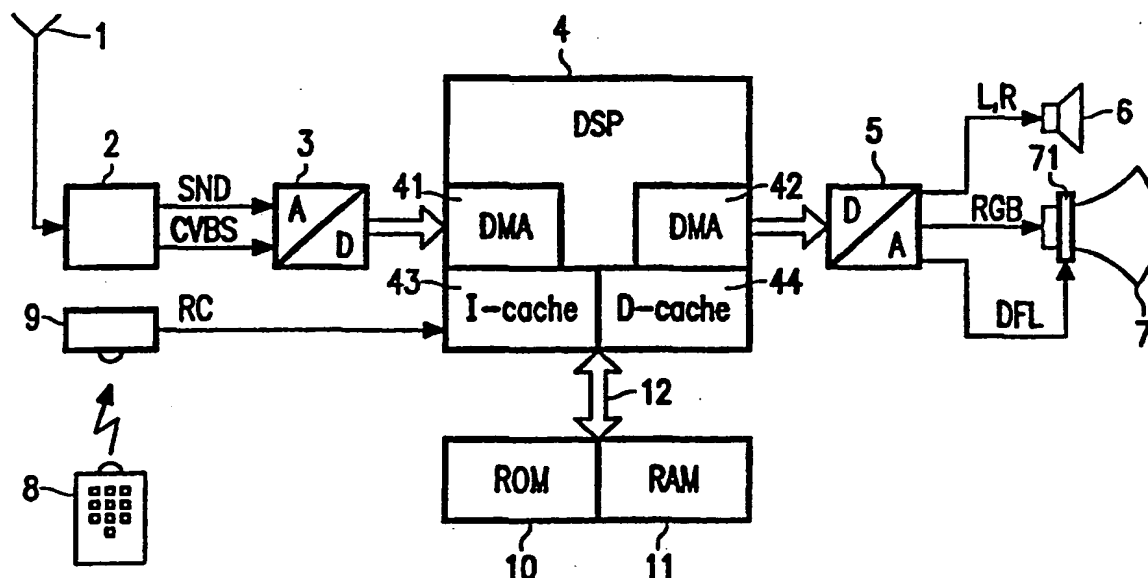
(57) Abstract

Television signal receiver (television apparatus, video recorder, CDI player) in which the plurality of processing operations to be executed (sync separation, subcarrier regeneration, colour decoding, teletext) is executed by a central processing unit (4). Each processing operation is stored in the form of a control program in a memory (10). The processing operations to be actually executed are selected and time-sequentially executed by the processing unit. The control programs to be executed are selected in dependence upon operating signals (TXT, PIP) or signal recognition (PAL, NTSC). Qualitatively different versions of some control programs are stored and the version which can be executed at the available processing capacity is selected.

Television signal receiver.

FIELD OF THE INVENTION

The invention relates to a television signal receiver comprising a plurality of processing means for executing respective processing operations on the received television signal. A receiver of this type is, for example a television apparatus, a video recorder or a CDI player.

5

BACKGROUND OF THE INVENTION

Receivers of the type described in the opening paragraph are generally known. The signal received from a tuner, tape or disc is subjected in the receiver to a plurality of processing operations each having a predetermined function. For example, a

10   television apparatus comprises, *inter alia* the following processing means:

-       a sync separator which separates synchronizing signals from the video signal from which it derives horizontal and vertical deflection signals for a display screen;
-       a colour decoder which splits the television signal into chrominance signals and

15   a luminance signal from which it generates three elementary colour signals R, G and B;
-       a teletext decoder which regenerates a data signal in the vertical retrace period of the television signal, stores the data of a selected page and reads, decodes and displays these data at a desired picture frequency;

20 -   an audio decoder for decoding the audio signal;
-       an operating circuit.

In the known television receivers said processing means are realised in the form of specially developed integrated circuits (ICs). Each IC has a given processing power for executing the processing operation which is determined to a considerable extent by

25   previously fixed requirements of picture quality, sound quality and convenience of operation. The processing power of an IC becomes manifest in the quantity of chip surface area. The plurality of ICs and peripheral components in the receiver represents the overall processing power of the receiver. This overall processing power is also dependent on the extent to

which the receiver has features such as teletext, picture-in-picture, stereo sound and multistandard reception.

The overall processing power of the known television receiver is determined by the sum of the processing power of all processing means. The processing power is fixed as soon as the ICs have been chosen and interconnected and is independent of the fact whether a given processing operation is executed or not executed. The functionality of the known receiver is also fixed invariably.

OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to provide a television signal receiver which is constructed in an alternative manner.

The receiver according to the invention is characterized in that each processing operation is laid down in a control program stored in a memory and in that the plurality of processing means is constituted by a processing unit which consecutively executes selected control programs in synchronism with the television signal.

Such a receiver is very flexible. This is understood to mean that functions can be modified or added by modification or addition of an appropriate control program. Due to this flexibility new apparatuses can be rapidly developed and marketed. By modifying or adding control programs, it is also possible to upgrade apparatuses which have already been manufactured. If desired, upgrading may even be carried out by the user, for example by means of a smartcard or by downloading data from a transmitter. A user may also give his television apparatus a personal touch. He may choose a sub-set of the stored control programs as long as the processing power of the processing unit is not exceeded.

An embodiment of the receiver is characterized in that the processing unit is adapted to select the control programs to be executed in dependence upon operating signals which are received from an operating unit. A further embodiment of the receiver is characterized in that the processing unit is adapted to select the control programs to be executed in dependence upon output signals of a processing operation. These embodiments are based on the recognition that a television receiver need not execute all processing operations simultaneously. Some processing operations are only necessary in user-selected operating modes (for example, teletext or picture-in-picture). Other processing operations are only necessary if a television signal in accordance with a given standard (PAL, SECAM, NTSC) is received. The processing power of the processing unit is thus adaptively used in said embodiments for the processing operations to be actually executed. No processing power

of the processing unit is necessary for a processing operation which is not executed. The
overall processing power may thus be smaller than that of the known receivers in which the
processing power of all processing operations is fully and continuously present.

A very favourable embodiment of the receiver is characterized in that at
least one processing operation is laid down in at least two control programs of different
complexity, the processing unit being adapted to select the most complex control program
which can be executed. For example, in a mixed TV/TXT mode, in which both colour
decoding and teletext decoding are operational, a less sophisticated teletext control program
may be executed than in a teletext-only mode. After a change of channels a qualitatively
better control program can also be executed for sync processing so that the receiver captures
a new station more rapidly at the expense of, for example a (temporarily) lower picture
quality.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 shows diagrammatically the structure of a television receiver
according to the invention.

Fig. 2 shows a possible division of an instruction memory shown in Fig.
1.

Figs. 3-6 show embodiments of a flow chart of a program which is
executed by a signal processor shown in Fig. 1.

DESCRIPTION OF EMBODIMENTS

Fig. 1 shows diagrammatically the structure of a television receiver
according to the invention. The receiver is connected to an antenna 1 and comprises a front-
end 2, A/D converters 3, a digital signal processor 4, D/A converters 5, one or more
loudspeakers 6, a display screen 7, a remote-control transmitter 8 and a remote-control
receiver 9. The signal processor 4 receives an intermediate frequency sound signal SND and
a composite video signal CVBS from the front-end 2. These signals are digitized by means of
the A/D converters 3. Moreover, the signal processor receives remote-control signals RC
from the remote-control receiver 9. Via the D/A converters 5, the processor applies audio
signals L and R to the loudspeakers 6, elementary colour signals RGB to the display screen 7
and deflection signals DFL to a deflection unit 71 secured to the display screen. Other
signals which are (or may be) present in practice are not shown for the sake of clarity. Extra
inputs and outputs, a second front-end for PIP, etc. are examples.

The digital signal processor 4 is preferably a high-performance processor having a RISC architecture (Reduced Instruction Set Computer), for example the type PA1700LC of Hewlett Packard or the type TMS320C90 of Texas Instruments. The processor can execute several hundred million operations per second on 16-bit or 32-bit data words and

5   is therefore eminently suitable for the real-time processing of video signals. The processor is coupled *via* a communication bus 12 to an instruction memory 10 of the ROM type and a data memory 11 of the RAM type. Samples of input signals, output signals and possible auxiliary signals are stored in the data memory 11. The storage of input signals of front-end 2 and reading of output signals for loudspeakers 6 and display screen 7 is effected by means

10   of Direct Memory Access (DMA) circuits 41 and 42, respectively, which are accommodated in signal processor 4. To minimize the load of the communication bus 12, the signal processor has cache memories. A first cache memory 43 is provided for temporarily buffering instructions from instruction memory 10, a second cache memory 44 is provided for temporarily buffering data words from/to data memory 11.

15   Fig. 2 shows a possible layout of the instruction memory 10. It comprises a plurality of control programs. More particularly, it comprises a control program 101 (CTRL) for processing remote control signals RC, a control program 102 (AUD) for demodulating the IF sound signal SND, a control program 103 (SYNC) for separating synchronizing signals from the video signal CVBS, a control program 104 (SUBC) for

20   regenerating the chrominance subcarrier, a control program 105 (COL) for decoding the colour signals from the video signal CVBS and a control program 106 (TXT) for teletext decoding and display. Each control program comprises instructions for processing data words in data memory 11 and/or data cache 44 by signal processor 4 (see Fig. 1). Each time, a time-limited portion of signals is processed. This may be one sample of a signal to be

25   processed (for example, one sample of the video signal) or a plurality of samples (for example a picture line or a frame). It will hereinafter be assumed that the signals are processed line by line. The instruction memory 10 shown in Fig. 2 further comprises a "supervisor" program 109 (SPRV) which determines which control program is executed by the signal processor and in which order these programs are executed. To this end the

30   supervisor successively loads, during a picture line, the control programs to be executed in the instruction cache of the signal processor.

In a first embodiment of the receiver, the supervisor loads and executes all control programs present in memory 10 successively. Fig. 3 shows a flow chart of the program which is accordingly executed by the signal processor. As has been attempted to

show in the Figure, the supervisor first loads the operating control program 101. This control program interprets the remote control signals and generates, *inter alia* an auxiliary signal TV/TX/MX indicating whether the receiver is in an operating mode "TV-only", "TXT-only" or "mixed TV/TXT". The control program CTRL also generates an auxiliary signal P which

5   defines the page number of a desired teletext page. Said auxiliary signals are stored in data cache 44 (see Fig. 1) so that they are accessible for other control programs. They are shown as broken lines in Fig. 3 so as to distinguish them from the solid lines indicating the order of processing operations.

Subsequently the supervisor loads the control program 102 (AUD) in the

10   instruction cache of the signal processor. Samples of the IF sound signal are decoded by this control program and samples of the audio signals L and R to be reproduced are computed.

In a corresponding manner, the control programs 103 (SYNC) for sync regeneration and 104 (SUBC) for chrominance subcarrier regeneration are subsequently loaded and executed. The control program SYNC generates the deflection signals DFL for

15   the display screen, as well as auxiliary synchronizing signals and for use by other control programs. The control program SUBC generates a regenerated subcarrier SC for use by other control programs. The auxiliary signals are again shown as broken lines.

Subsequently the supervisor loads the control program 105 (COL). This control program processes all video samples of a picture line so as to obtain a displayable

20   RGB picture signal. As is shown in the Figure, the control program COL uses the auxiliary signals H, V and the subcarrier SC.

Subsequently, the control program 106 (TXT) is executed. This control program decodes a teletext signal during the vertical retrace and acquires a desired page. To this end the control program uses the auxiliary synchronizing signals H, V and the page

25   number P. The acquired page is translated into RGB pixels which are stored in data memory 11 (see Fig. 1) for later display. Dependent on the auxiliary signal TV/TX/MX, the RGB picture signal generated by the control program COL is hereby completely overwritten (TXT only), partly overwritten (mixed TV/TXT) or not overwritten (TV only).

The control programs AUD, SYNC, COL and TXT which generate an

30   output signal intended for reproduction and display (audio signals L and R, deflection signals DFL, RGB picture signal, teletext pixels) store the obtained samples *via* data cache 44 in data memory 11. The samples are subsequently applied in an autonomic way to the loudspeakers 6 and the display screen 7 by means of the DMA circuit 42.

The processing operations described are performed each picture line so

that real-time display and reproduction of picture and sound takes place. Loading each control program in the instruction cache of the signal processor and the subsequent execution of the operation always takes a given execution time. This time is dependent on the computing capacity of the signal processor and the complexity of the control program. In the

5   embodiment of Fig. 3 it is assumed that all control programs can be executed within the available line period of 64 μsec. Computations and practical experiments have proved that the control programs for operation, synchronization and subcarrier regeneration are relatively simple and require a short execution time. The control programs for audio processing, colour decoding and teletext are, however, rather large. It should also be noted that in practice

10   additional control programs are desired for functions such as processing external signals, picture-in-picture display, multistandard reception, picture enhancements such as noise reduction, and the like.

        Embodiments of the receiver will hereinafter be elucidated, in which the signal processor cannot execute all control programs within the available time. Fig. 4 shows

15   the flow chart of an embodiment in which the supervisor is adapted to select the control programs to be executed in dependence on operating signals. Entirely analogous to the flow chart of Fig. 3, the control programs CTRL, AUD, SYNC and SUBC are consecutively loaded and executed. It is assumed that these operations take 14 μsec so that the remaining line period is 50 μsec. This period is insufficient for executing both the control program

20   COL (40 μsec) and the control program TXT (20 μsec). The supervisor SPRV now receives the auxiliary signal TV/TX/MX which is generated by the user and is applied to the supervisor by the control program CTRL. With reference to this auxiliary signal, the supervisor decides whether the control program COL (in the operating mode "TV only") or the control program TXT (in the operating mode "TXT only") is loaded. This is symbolically

25   indicated in the Figure by means of a switch 40. The operating mode "mixed TV/TXT" is not possible in this embodiment.

        Fig. 5 shows the flow chart of an embodiment in which also the "mixed TV/TXT" mode is implemented. In this embodiment the instruction memory comprises two different versions of the control program COL for colour decoding: a complex version 105a

30   (COL1) having a high picture quality and an execution period of 40 μsec and a simpler, less qualitative version 105b (COL2) having an execution period of 25 μsec. In practice such a simpler version is obtained by using, for example shorter filter lengths in the colour decoding algorithm. As is symbolically shown by means of switch 50 in Fig. 5, the supervisor loads the complex control program COL1 in the operating mode "TV only", the control program

TXT in the operating mode "TXT only" and consecutively the simpler control program
COL2 and the control program TXT in the operating mode "mixed TV/TXT". The execution
period of COL2 and TXT combined is 45 μsec and can be executed within the rest of the
line period.

5   Many variations of the embodiment shown in Fig. 5 are possible. A useful
alternative is to implement a colour decoder having a good quality and two different versions
of the teletext decoder, for example a simple single-page low- resolution decoder in the
mixed mode and an advanced multipage high-resolution decoder in the "TXT only" mode.
           Fig. 6 shows the flow chart of an embodiment in which the supervisor
10   selects the control programs to be executed in dependence upon output signals of other
control programs. In this embodiment the instruction memory also comprises two different
versions of the control program COL for colour decoding, a version 105c (COL-PAL) for
PAL signals and a version 105d (COL-NTSC) for NTSC signals. Again analogously to the
foregoing, the control programs CTRL, AUD, SYNC and SUBC are consecutively loaded
15   and executed. In this embodiment, the control program SUBC for regenerating the
chrominance subcarrier detects whether the subcarrier frequency is 4.43 MHz or 3.58 MHz
and passes on this information to the supervisor. Dependent thereon, the supervisor now
selects the PAL or NTSC version of the colour decoder by means of the switch 60 which is
shown symbolically.

20   Another example of an embodiment in which the supervisor selects the
control programs to be executed in dependence upon output signals of other control programs
is obtained if one of the control programs is a measuring program for measuring the quality
of the received signal, for example the quantity of noise. Dependent thereon, a control
program for suppressing noise can be selected.

25   If desired, the embodiments described hereinbefore may be combined. For
example, by combining Figs. 5 and 6, a multistandard PAL/NTSC receiver is obtained which
in the mixed TV/TXT mode either activates a less advanced form of colour decoding or
provides fewer teletext facilities.

           It is further possible to load a more complicated version of a given control
30   program as there is more execution time available for this program. The available time may
even vary dynamically if the execution time of processing operations is variable. For
example, the execution time of the control programs COL and TXT within the vertical field
retrace period is shorter than outside this period because it is not necessary to generate a
picture. During this retrace period a more advanced version of the control program SYNC

can be loaded. It is also possible to temporarily use extra processing power for synchronization and less power for colour decoding after a change of channels, so that the receiver rapidly displays a stable picture.

Claims:

1.   A television signal receiver comprising a plurality of processing means for
executing respective processing operations on a received television signal, characterized in
that each processing operation is laid down in a control program stored in a memory and in
that the plurality of processing means is constituted by a processing unit which consecutively
5   executes selected control programs in synchronism with the television signal.

2.   A receiver as claimed in Claim 1, characterized in that the processing unit
is adapted to select the control programs to be executed in dependence upon operating signals
which are received from an operating unit.

3.   A receiver as claimed in Claim 1 or 2, characterized in that the processing
10   unit is adapted to select the control programs to be executed in dependence upon output
signals of a processing operation.

4.   A receiver as claimed in Claim 1, 2 or 3, characterized in that at least one
processing operation is laid down in at least two control programs of different complexity,
the processing unit being adapted to select the most complex control program which can be
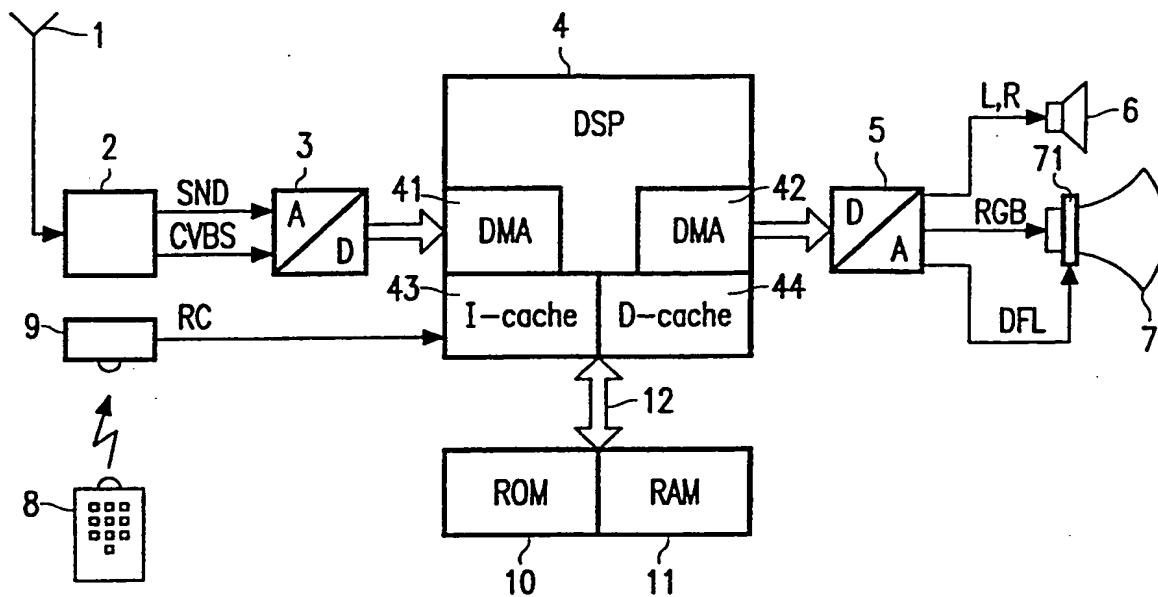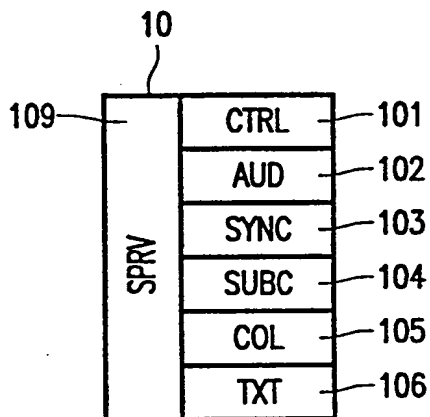15   executed.

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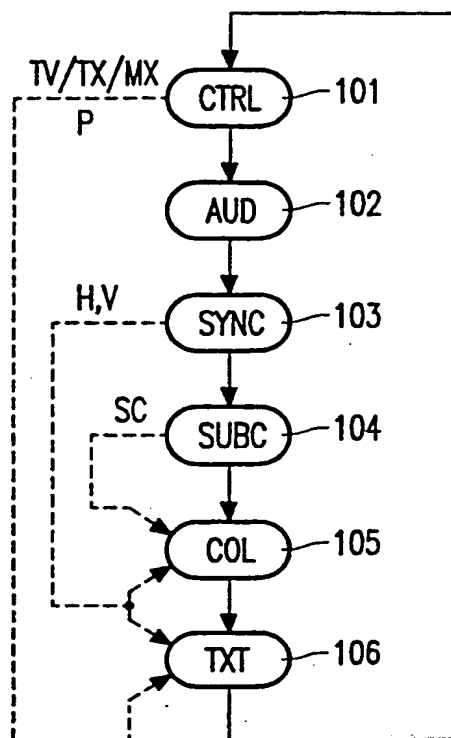
FIG. 1

FIG. 2
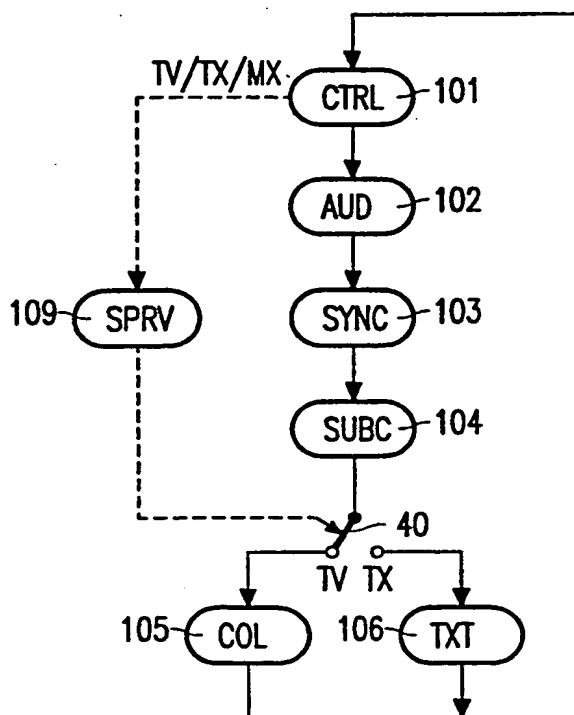
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FIG. 3

FIG. 4

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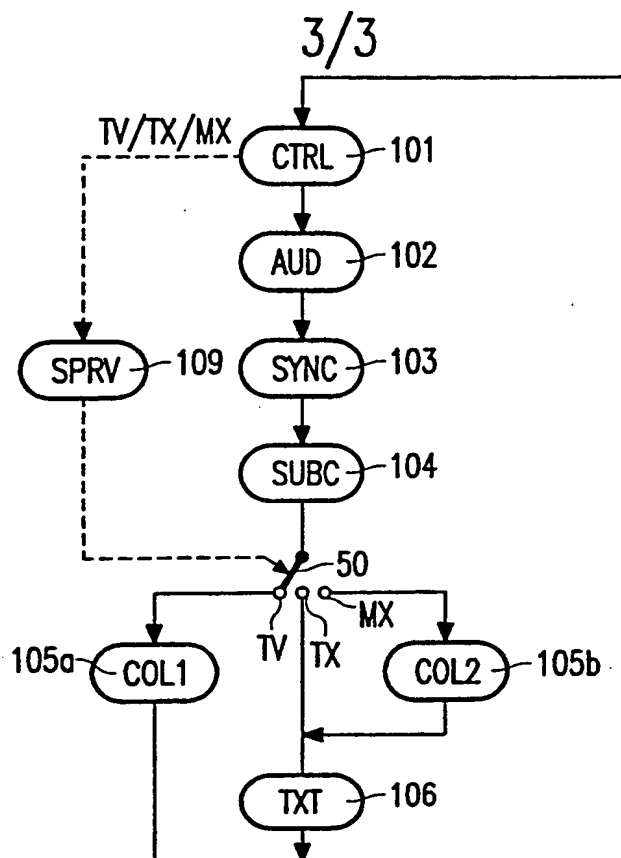
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TV/TX/MX

CTRL — 101

AUD — 102

SPRV — 109   SYNC — 103

SUBC — 104

50

MX

105a — COL1   TV TX   COL2 — 105b

TXT — 106

FIG. 5

CTRL — 101

AUD — 102

SYNC — 103

4.43/3.58MHz   SUBC — 104

SPRV — 109

60

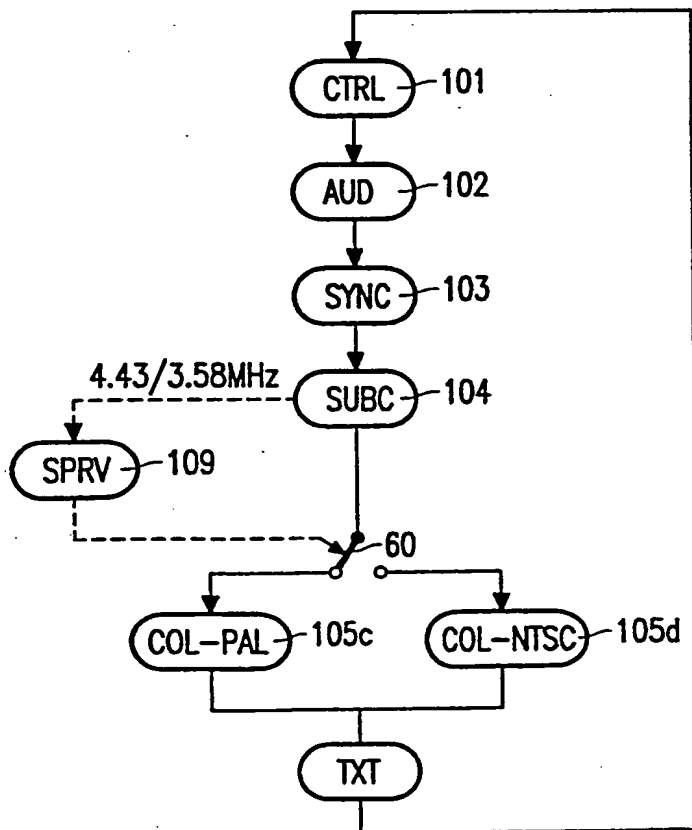COL-PAL — 105c   COL-NTSC — 105d

TXT

FIG. 6

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00461

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04N 5/44, H04N 5/46, H04N 9/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04N, G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0529442 A2 (KABUSHIKI KAISHA TOSHIBA), 3 March 1993 (03.03.93), column 2, line 15 – line 17; column 2, line 32 – line 36; column 4, line 43 – line 45, figure 1	1,2
Y		3,4

A	EP 0574901 A2 (KABUSHIKI KAISHA TOSHIBA), 22 December 1993 (22.12.93), column 6, .line 53 – line 55; column 12, line 38 – line 43; column 23, line 51 – line 53, figures 1,23, boxes S64, S65 in fig 25	1,2
Y		3,4

[X] Further documents are listed in the continuation of Box C.	[X] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	erlier document but published on or after the international filing date	"X"	document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 November 1995	25.11.95
Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Bengt Jonsson Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00461

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5285264 A (AKIRA MATSUSHITA), 8 February 1994 (08.02.94), column 8, line 17 - line 20; column 18, line 9 - line 12; column 18, line 21 - line 23	1
A		2-4

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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A2- 0529442	03/03/93	JP-A-	5056372	05/03/93
		KR-B-	9505603	27/05/95
		US-A-	5264931	23/11/93
EP-A2- 0574901	22/12/93	NONE		
US-A- 5285264	08/02/94	EP-A,A,A	0449075	02/10/91
		JP-A-	3283976	13/12/91